CALIPSO Optical Depth Distributions and Comparison with GLAS

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1. Introduction

Satellite-borne lidars can measure the vertical distribution of clouds at greater detail than ever before possible. The Ice, Cloud, and Land Elevation Satellite (ICESat) Geoscience Laser Altimeter System (GLAS) measures cloud heights globally in a precessing orbit that permits viewing at different times of day each month. The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite (CALIPSO) with the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) is in a Sun-synchronous orbit with an equatorial crossing time of 1330 LT. CALIOP and GLAS measure clouds with similar sensitivities. The results shown here are a preliminary comparison of CALIPSO, GLAS and CERES clouds, where optical depth distributions, as well as cloud fractions and cloud heights, are compared.

2. Data & Comments

CALIPSO level-2 5 km cloud layer heights and optical depths (tau) are used:
✓ October 2006

GLAS level-2 middle resolution 532-nm cloud layer heights (GLA09) are used:
GLAS level 2 cloud optical depths (GLA11) are used:
✓ October, 2003

- October measurements were taken nearly 6 hours apart.
- Since GLAS has optical depth measurements only for Oct. 2003 and CALIPSO was not launched until June, 2006, comparisons are made for different years.

Discrepancies in cloud amounts and optical depths remain to be explained. They are most likely due to different sensitivities of the two lidar systems and processing algorithm differences
- CALIPSO detects more clouds with tau < 0.1 than GLAS
- CALIPSO less sensitive to day-night background changes than GLAS
- CALIPSO discrimination between clouds with tau > 1.5 and > 3 may need further work
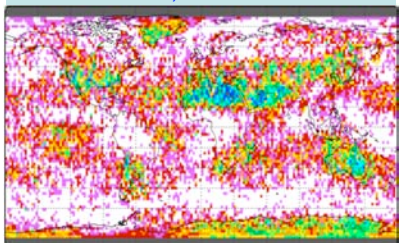- CERES detection limit of tau > 0.3 accounts for much of difference wrt CALIPSO & GLAS

3. Results

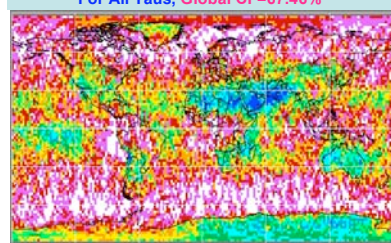### 3.1 Optical Depth Distributions for October 2006 (CALIPSO), 2003(GLAS)
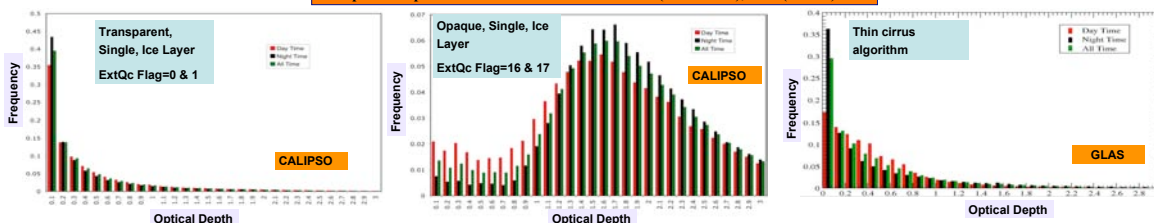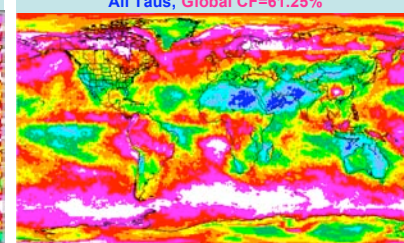

3.2 Cloud Fraction (Global Maps)

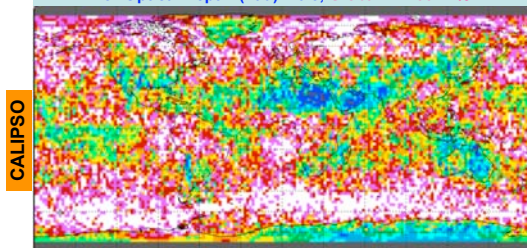**CALIPSO:** Day+Night, Oct. 2006, Cloud Fraction, For All Taus, Global CF=80.07%

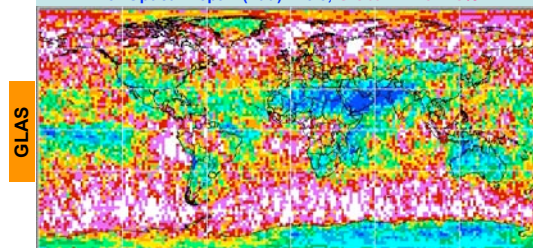**GLAS:** Day+Night, Oct. 2003, Cloud Fraction, For All Taus, Global CF=67.46%

CERES-MODIS: Day+Night, Oct. 2006, Cld Fraction All Taus, Global CF=61.25%

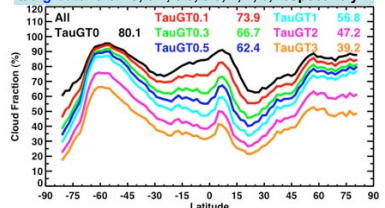**CALIPSO:** Day+Night, Oct. 2006, Cloud Fraction For Optical Depth (Tau) > 0.3, Global CF=66.74%

GLAS: Day+Night, Oct. 2003, Cloud Fraction, For Optical Depth (Tau) > 0.3, Global CF=61.13%
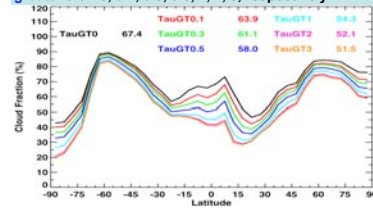
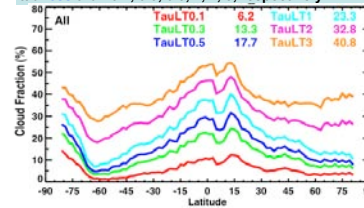### 3.3 Cloud Fraction (Zonal Means as a Function of Optical Depth)

CALIPSO: day+night, Oct 2006. Cloud fractions for tau greater than 0, 0.1, 0.3, 0.5, 1, 2, 3, respectively.

GLAS: day+night, Oct 2003. Cloud fractions for tau greater than 0, 0.1, 0.3, 0.5, 1, 2, 3, respectively.
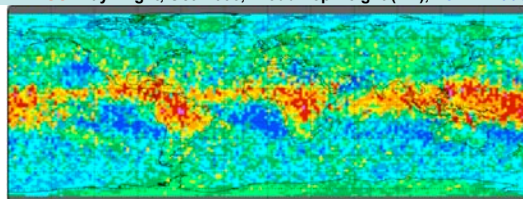
CALIPSO: day+night, Oct 2006. Cloud fractions for tau less than 0.1, 0.3, 0.5, 1, 2, 3, respectively.
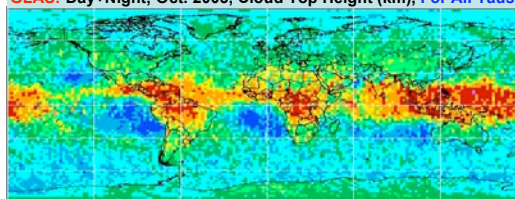
3.4 Cloud Height (single & multi, highest cloud layer)

CALIPSO: Day+Night, Oct. 2006, Cloud Top Height (km), For All Taus — Global Mean = 7.45 km

GLAS: Day+Night, Oct. 2003, Cloud Top Height (km), For All Taus — Global Mean = 7.55 km